

Continuous observations were obtained at the summit of El Misti by means of the new meteorograph.

By an arrangement with the Park Commissioners for the city of Boston the upper portion of Blue Hill was purchased in 1875 and transferred to the care of the Harvard observatory. This hill is about eight miles south of the observatory, and upon it was placed one of the transit circle meridian marks when the observatory was first erected by W. C. Bond in 1838. Thus it happens that the Blue Hill Observatory now comes under the general supervision of Professor Pickering and the authorities of Harvard University, but, of course, without interfering with the independence of this coordinated institution. Professor Pickering's annual report states that a description of the method of exploration of the upper air with kites, with a discussion of the observations, from 1894 until the beginning of 1897, forms an appendix to the observations of 1896 in Vol. XLII, Part I of the "Annals," now in course of publication. He also adds that the observations of the New England Weather Service will not hereafter appear in the annals of the observatory, but will be "published in the Monthly Weather Review," by which latter name he, undoubtedly, intends "the Monthly report of the New England Section of the Climate and Crop Service of the Weather Bureau." These monthly reports from the various sections contain a great deal of information that is not given in the MONTHLY WEATHER REVIEW published at Washington, which latter can at best give but a brief summary of the details given in these reports.

IMPORTANCE OF THE MONTHLY REPORTS OF THE SECTIONS.

These monthly section reports are, we fear, not always appreciated as they should be, as a permanent detailed record of our climatic data. The set of twelve numbers for each year should be preserved and bound by each recipient, or if more convenient, presented to some library where it will be properly cared for and generally accessible to the public. If sets of these could be presented to the prominent Government weather bureaus throughout the world, and personally to those who are known to be active students of climatology, they would, undoubtedly, contribute to remove much of the ignorance that prevails with regard to the climate of America.

METEOROLOGY IN THE UNITED STATES GEOLOGICAL SURVEY.

There are, of course, many matters that must be attended to in the prosecution of the duties imposed upon the Director of the Geological Survey that bear closely upon meteorology and the work of the Weather Bureau. There is apparently no duplication of work in these two bureaus, but each must carry on certain parallel lines of work in order to accomplish the object it has in view. On looking over the eighteenth annual report of the director of the survey, for the fiscal year ending June, 1897, we note the following items that will interest the students of American climatology. First of all we must mention the magnificent topographical survey and the published maps without which one can not understand the climatology of any portion of the country, so much does the climate of any spot depend upon its elevation, its aspect, and its drainage. Precise levelings, in the geodetic sense of the word, are made by the Coast and Geodetic Survey, but the detailed plane-table survey belongs to the topographic division of the Geological Survey.

The altitude of the cistern of the barometer is believed to be now known for every Weather Bureau station, by the help of the accurate levels made first for railroad and canal work and now by the Geodetic and the Topographic Surveys. It has sometimes been erroneously assumed by European meteorologists that the altitudes used in reducing American

stations to sea level were necessarily approximate barometric determinations.

Very few have realized the great value of the accurate levelings that have extended over this whole country in connection with the building of railroads and canals. Extensive collections of these levels were first made by Mr. Ellet; these were further supplemented by other data collected by Mr. William Nicholson for the Smithsonian Institution, which were intended as a contribution toward a hypsometric map of North America. Such a map was first prepared by Mr. Schott for the statistical atlas, published in 1874 in connection with the Census of 1870. This data was still further increased by the work done by myself in preparing the revised altitudes of Signal Service stations adopted in November, 1872, which was also the first extensive effort to adjust the discrepancies along the various lines. The work has since then been greatly extended by Mr. Gannett, on behalf of the Hayden Survey and the United States Geological Survey.

The geologist often fills in many details by the help of the barometer, using the differential methods. The method perfected by Gilbert and Gannett for this barometric hypsometry constitutes another point of contact between the work of the Weather Bureau and that of the Geological Survey.

By its study of the glacial drift the Survey contributes to our knowledge of the distribution of ice and snow as the principal climatic feature in one of the ancient eras. In this connection also the study of the water stored up in the soil, as collected from artesian wells, mineral springs, and ordinary wells has not only a direct bearing upon present agricultural possibilities, but upon past climates.

It is found that great agricultural differences arise from varying degrees of porosity of the several classes of glacial and glacial-river deposits. This leads to the conviction that a classification of soils, based upon their relation to the glacial agencies by which they were formed, would be of fundamental importance to agriculture.

Observations have been made by the Survey in a very deep well which is being drilled near Pittsburg and which will probably extend more than a mile into the earth. If such a well can be continued downward far enough to entirely escape the temperature conditions that prevail among the various sedimentary strata near the surface of the globe, it must, eventually, give us much information that will elucidate the evolution of our globe and our atmosphere.

In the division of hydrography, under Mr. F. H. Newell, measurements or computations of the water discharge of the rivers have been made for about 170 rivers, fairly well distributed over the Atlantic and Pacific States and in the interior. In this connection measurements of seepage and measurements of rainfall have, of course, also been made. As the windmill is extensively used in raising water for irrigation, therefore special studies have been made upon the employment and efficiency of windmills. These memoirs, by Barbour, Murphy, and Hood, constitute a first installment of the important work that was commended to the attention of all concerned by the Editor of the MONTHLY WEATHER REVIEW in April, 1895, Vol. XXIII, page 131, in an article on "The Efficiency of Windmills and Farmers' Tools." The measurements of rainfall, evaporation, seepage, and river discharge constitute the fundamental data by means of which we get an approximate idea of the quantity of water that passes back into the atmosphere from the surface of the continent, as distinguished from that which comes from the ocean and from frozen lakes, rivers, and snow beds. These data have also an important bearing on the problems that are involved in every effort to predict the floods and low waters of our rivers, a work that is especially committed to the Weather Bureau.

The most recent addition to the work of the Survey has

been the mapping and description, and probably, eventually, the care of the national forest reserves. This opens up a new branch of work in which temperature, rainfall, wind, and other meteorological conditions must be considered.

On page 116 of Mr. Walcott's report as director he states:

The preparation of a physical atlas of the United States, upon which much work had been done in former years, was continued. Climatic maps were prepared, which include maps of mean monthly temperature, of annual pressure, cloudiness and snowfall, monthly and annual maps of relative humidity, and maps showing the range in temperature between the hottest and coldest months; in all 28 maps. Besides these diagrams have been prepared of the slopes of the rivers of the United States.

As nearly all the climatic data for the United States is preserved in the archives of the Weather Bureau, it would seem that the climatic maps prepared by the Geological Survey must be essentially the same as those prepared by the Weather Bureau. There are, undoubtedly, frequent inquiries for a physical atlas and, so far as meteorological elements are concerned, the Weather Bureau has furnished its data freely to all inquirers and has published that for which there seemed to be the greatest demand. Plans for a national physical atlas were submitted by Prof. Joseph Henry in 1847 for publication by the Smithsonian Institution. An atlas of this character was published by Gen. Francis A. Walker, in connection with the census of 1870, to which, at the suggestion of the present writer, the Weather Bureau contributed four meteorological charts. When Mr. Gannett was assigned to duty in the Census Bureau as geographer, in addition to his duties as Topographer in the Geological Survey, many climatic charts were prepared by him for the publications of the census of 1880, and a revision of these was begun for the eleventh census of 1890. It is evident that by the proper cooperation of the Weather Bureau (as to meteorology and hydrology), the Geological Survey (as to topography, hydrography, seismology, geology, and mineral springs), the several divisions of the Department of Agriculture (as to soils and forests), and the Coast and Geodetic Survey (as to magnetism, terrestrial gravity, and tides), our national government is now in a position to prepare a physical atlas of the United States, embracing every branch of terrestrial physics. An atlas that does not embrace all these must, necessarily, be incomplete and more or less unsatisfactory. A joint work for which each Department of the Government assumes the proper responsibility would respond to a recognized desideratum.

RECENT EARTHQUAKES.

Prof. Edward W. Morley, of Adelbert College, Cleveland, Ohio, and Prof. C. F. Marvin, of the Weather Bureau at Washington, report that no earthquakes have been recorded on their respective seismoscopes during December.

December 2.—Medicine Lodge, Kans.: about 12:45 a. m. a slight shock was experienced in this locality. Duration, about five seconds; direction, south to north. Rome, Kans.: about 1 a. m. Jefferson, Okla.: at 1:10 a. m. an earthquake shock, quite severe; rocked buildings, making them creak and crack; the disturbance seemed to be from northwest to southeast.

December 6.—Forest Grove, Oreg.: slight shock at 8:30 p. m.

December 15.—Waterville, Wash.: earthquake; duration four to six seconds; direction, northwest to southeast. Lakeside, Wash.: A severe shock.

December 15.—At 6:43 a. m., local time, severe earthquake, causing great damage throughout San Domingo. A second slight movement at 2 p. m. Churches and buildings were destroyed and railroad traffic interrupted. The submarine cable to Hayti was also affected. The grand edifice of Santo Cerro, in Santiago, in the interior of San Domingo, dating from the time of Columbus, was entirely destroyed. A con-

tinued repetition of harmless shocks occurred until the end of the month.

December 16, 17, 20.—Lakeside, Wash.: light shocks, all occurring at 6 a. m., vibrating from west to east.

December 18.—Earthquakes were reported at Ashland, Va., 6:54 p. m.; slight shock, with heavy rumbling noises, lasting from twenty to thirty seconds. Richmond, Va.: Shortly before 7 p. m. earthquake noticeable everywhere, but more violent in the eastern part of the city, toward Oakwood. At Oakwood it was heard and felt very distinctly. At Bonair and throughout Henrico County, Va., it was heard and felt; also at Buckingham and Maidens at 6:49 p. m., and at Fredericksburg.

December 26.—Centerville (P. O. Niles), Cal.: earthquake 7:06 a. m.; duration, five seconds; direction, north to south.

December 29.—Cockburn Town, Grand Turk, W. I.: Mr. Geo. J. Gibbs reports:

On the morning of Wednesday the 29th day of December, 1897, at about 6:37 o'clock a. m., a slight shock of earthquake was felt at the Island of Grand Turk, lasting a few seconds. No damage was done; it was sufficiently strong, however, to stop the movement of the Government clock at the public buildings, and also several other timepieces in this town; symptoms of nausea were experienced by some of those who felt the trembling of the earth.

ELECTRIC STORMS AT SACRAMENTO.

The cause of the electrification of the atmosphere, from which follows the electrical phenomena of the thunderstorm, will, of course, not be understood until we have been able to explain how it happens that in some sections of the world there are so few thunderstorms, while in others they are of almost daily occurrence. A portion of California is singularly free from lightning, as shown by the following compilation from the records of the Weather Bureau station at Sacramento. The Weather Bureau station at this place was opened July 1, 1877, and the daily journal kept at the station probably affords a complete list of all the thunderstorms (viz, even a slight display of thunder or lightning) that have occurred. The following is the complete list of dates as corrected and continued from the list published on page 105 of Mr. Barwick's Monthly Bulletin of the California Weather Service for June, 1893:

1877.—July 20.

1878.—January 22; March 20; May 28; August 15.

1879.—March 30; April 4, twice; May 25; October 7.

1880.—March 3; June 11; July 25.

1881.—April 9, 21; May 23; June 3.

1882.—March 15; June 14; July 3; September 15.

1883.—March 27; May 6.

1884.—May 17, 18, 19.

1885.—April 2, 7, 8; September 5, 6; October 6.

1886.—January 20; March 4; April 9.

1887.—May 30; September 22; November 5.

1888.—May 12, 13; September 14, 15, three storms.

1889.—March 10, 20; April 2; October 8, 21; November 18.

1890.—February 16; May 10; December 3.

1891.—February 22; April 13; May 18; September 5.

1892.—September 26, 29, 30.

1893.—March 11; May 17; September 6.

1894.—May 25; June 17.

1895.—April 27; June 28; October 11.

1896.—May 27.

1897.—August 18, 19; December 1.

In most cases the display of lightning and thunder was very slight. The following notes refer to interesting cases:

1885, October 6, forked lightning occurred in the shape of a horseshoe.

1887, September 22, brilliant and long flashes of zigzag or forked lightning.

1888, September 14, 15, there were five distinct and severe storms with lightning and thunder in the vicinity of Sacramento during these two days.